

insulating layer are connected to each other in a region in contact with said gap so that heat can be conducted therebetween.

29. (New) A thermal head comprising:

a metal substrate;

an insulating layer formed on the surface of said metal substrate;

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cont . a plurality of heating elements disposed on the surface of said insulating layer, said heating elements being arranged with a predetermined pitch along a plurality of lines in a main scanning direction, said plurality of lines being spaced from each other in a paper feeding direction perpendicular to the main scanning direction; and

a heat radiating element projecting from the surface of said metal substrate to the side where said insulating layer is disposed,

wherein said heating elements are disposed such that the location, in the main scanning direction, of each heating element is shifted by 1/2 pitch relative to the location of one of heating elements arranged in an adjacent line.

REMARKS

Favorable reconsideration of this application, in light of the following discussion, is respectfully requested.

Claims 1-29 are pending; Claims 10-25 have been withdrawn from consideration; Claim 1 has been amended; and Claims 26-29 have been newly added herewith. It is respectfully submitted that no new matter has been added by this amendment.

The present invention relates to a thermal head capable of printing two lines at the same time using two lines of heating elements. The present invention enables high speed printing operation through the use of a thermal head capable of performing preheating using one of the two lines of heating elements while performing printing using the other of the two

lines of heating elements. Specifically, a heat radiating element projected from the surface of the metal substrate is provided. A current does not flow in the heat radiating element. If a current flows in the heat radiating element, it does not have a proper heat radiating function, because heat is generated in the heat radiating element and the substrate by the current. In the present invention, the heating element is heated by a current flowing from control IC 19 to the common electrode 16. Thus, in the heat radiating element according to Claim 1, a current to heat the heating element does not flow.

With regard to the rejection of Claims 1, 2, 4-6, 8, and 9 under 35 U.S.C. § 102(b) as clearly anticipated by Sugiyama (WO 9958340, hereafter WO '340), this rejection is respectfully traversed. WO '340 describes, with regard to Figures 19 and 20:

1903 denotes a protrusion, which is to be a common electrode section [and] the first exothermic bodies 1905 and the second exothermic bodies 1904 are connected in series for each dot, and connection points between each one end of the first exothermic bodies 1905 and each one end of the second exothermic bodies 1904 are earthed via the common electrode 1912. The other ends of the second exothermic bodies 1904 are connected to a control circuit (a control IC in the illustrated example) 1950 via individual electrodes 1908. This control IC 1950 is interposed between the second exothermic body 1904 and the power source 1951 to drive the second exothermic bodies 1904 with a predetermined power source.

Therefore, as may be understood from the above description, a current flows in the protrusion 1903.

As explained above, and as recited in Claim 1, current does not flow through the heat radiating element to the heating elements in the present invention. Accordingly, because WO '340 has a current flowing in the protrusion 1903, it is respectfully submitted that pending Claims 1, 2, 4-6, 8, and 9 patentably distinguish over WO '340.

With regard to the rejection of Claims 1, 2, 4-6, 8, and 9 under 35 U.S.C. § 102(b) as clearly anticipated by Sugiyama (JP 10-138541, hereafter JP '541), this rejection is

respectfully traversed. Claim 1, from which Claims 2, 4, 5, 6, 8, and 9 depend, recites that current does not flow through the heat radiating element to the heating elements.

By contrast, JP '541 relates to a structure where the substrate is heated by a common current flowing through the projections. With this type of structure, it is difficult to control the heating elements independently of each other. As described in the Description of the Related Art of the present specification, at page 3, lines 4-10, for example, the present invention relates to improving printing performance by being able to control the heating elements independently. Accordingly, because JP '541 suffers from the exact difficulties of the Applicants' invention is designed to overcome and fails to disclose or suggest that a current does not flow through the heat radiating element to the heating elements, it is respectfully submitted that pending Claims 1, 2, 4-6, 8, and 9 patentably distinguish over JP '541.

With regard to the rejection of Claims 1, 2, 4-6, 8, and 9 under 35 U.S.C. § 102(b) as anticipated by Sugiyama (JP 10-151784, hereafter JP '784), this rejection is respectfully traversed. Claim 1, from which Claims 2, 4-6, 8, and 9 depend, recites "current does not flow through said heat radiating element to said heating elements."

JP '784 is representative of the difficulties described in specification in the section entitled Description of the Related Art at page 3, lines 4-10. Specifically, as described with regard to Figure 24, "The substrate 602 is heated by a common current flowing through the projection 603 which is a part of the substrate 602. As a result, thermal interference occurs between the heating element 608 and the heating element 611. This makes it difficult to control the heating elements 608 and 611 independently of each other." As a result, JP '784 suffers from thermal interference between the heating element 608 and the heating element 611, which makes it difficult to control the heating element 608 and 611 independently of each other.

Consequently, as independent Claim 1 recites that current does not flow through the heat radiating element to the heating elements, it is respectfully submitted that Claims 1, 2, 4-6, 8, and 9 patentably distinguish over JP '784. It is therefore respectfully requested that this rejection be withdrawn.

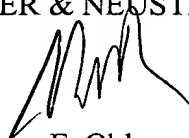
Applicants acknowledge with appreciation the indication that Claims 3 and 7 contain allowable subject matter. The subject matter of Claims 3 and 7 has been incorporated into newly added Claims 28 and 29. Accordingly, it is respectfully submitted that no new matter has been added by the addition of Claims 28 and 29, and that Claims 28 and 29 are in condition for allowance.

In addition, it is respectfully submitted that newly added Claims 26 and 27 recite subject matter not disclosed or suggested by the references of record. For example, the configuration recited in Claim 26 recites that the heating element 14 is separated from the heating element 24 as shown in Figures 1, 2, and 3. By contrast, in the references of record, the first heating element and the second heating element are electrically connected so as to be connected to the common electrode, namely connected to the protrusion from the substrate. For example, in Figure 19 of WO '340, each one end of the first exothermic bodies 1905 and each one of the second exothermic bodies 1904 are connected via the common electrode 1912. Similarly, the configuration recited in Claim 27 patentably distinguishes over the references of record. According to the present invention, for example as depicted in Figures 1, 2, and 3, electrode 16 is provided on the opposite side of the metal side of the substrate relative to the insulating layer, so as to be insulated from the substrate 1. On the other hand, in the references, the electrode is electrically connected to the substrate via the protrusion. For example, in Figure 19 of WO '340, the electrode 1912 is electrically connected to the substrate 1902 via the protrusion 1903.

Consequently, in view of the foregoing discussion and present amendments, it is respectfully submitted that this application is in condition for allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Please amend Claim 1 as shown below.

1. (Amended) A thermal head comprising:

a metal substrate;

an insulating layer formed on the surface of said metal substrate;

a plurality of heating elements disposed on the surface of said insulating layer, said heating elements being arranged with a predetermined pitch along a plurality of lines in a main scanning direction, said plurality of lines being spaced from each other in a paper feeding direction perpendicular to the main scanning direction; and

a heat radiating element projecting from the surface of said metal substrate to the side where said insulating layer is disposed,

wherein current does not flow through said heat radiating element to said heating elements.

Claims 26-29 (New)